



NASA Procedural Requirements

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COMPLIANCE IS MANDATORY

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Subject: NASA General Safety Program Requirements

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Appendix I: Supplemental Meteoroid Information

The sporadic meteoroid complex as observed from Earth is known to have four major sources in six radiant distributed symmetrically about the celestial sphere. In this Appendix, describing the locations of these different sources is done using a Sun-centered coordinate system. Referring to the Jones and Brown orbital survey paper of 1993, the primary sporadic meteoroid sources are the Helion/Anti-Helion, the North/South Apex, and the North/South Toroidal; these three sources are associated with cometary material. Sporadics from the Helion source at ~342° solar longitude appear to originate from near the Sun; Anti-Helion sporadics, at ~198° solar longitude, appear to originate opposite the Sun and are thought to consist of material from short-period comets, such as Comet D'Arrest. The Apex source, broken up into North Apex and South Apex branches, straddles the ecliptic plane in the direction of Earth's motion at ~270° and is comprised of material from long-period comets, like Comet Hyakutake. The Toroidal source, divided into North Toroidal and South Toroidal branches, has high ecliptic latitudes above and below the Earth resembling a toroid around the Earth's orbit. The source of these particles is less well understood, but current work points to the Halley family of short period comets. The fourth and least understood source is the Asteroidal source. Observed asteroidal meteoroids are predicted to come from directions close to the ecliptic poles, at about ±90°.

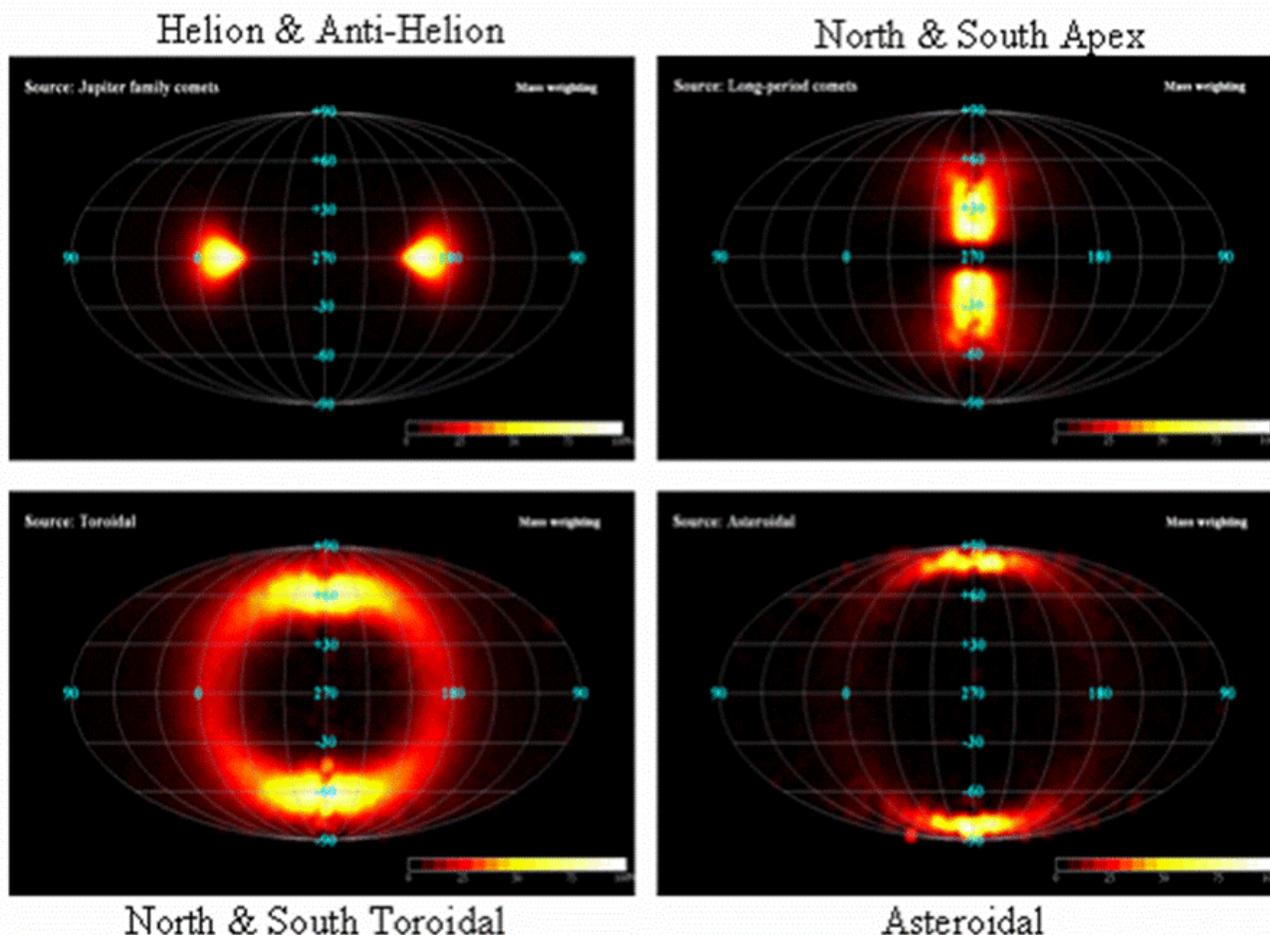


Figure I-1. Sporadic meteoroid radiants

Each of the four sources has a relative strength and a speed distribution (see Figure I-2 for individual source distributions). MEM accounts for these varying source strengths and speed distributions and has initially been validated against radar observations from the Canadian Meteor Orbit Radar (CMOR) and corrected for known biases to the best ability of the developers. The total average cross-sectional flux as a function of mass as given by the interplanetary model at 1 AU follows the same mass index as the popular Grün/Zook mass index reported in NASA TM 4527 and SSP 30425. These values for average cross-sectional flux are within 2 percent of the daily flux values as reported by CMOR. This average cross-sectional flux does contain meteor shower fluxes but in an average sense only. Meteor storms and outbursts should be modeled separately and the risks mitigated operationally; a listing of major annual showers is given in Table I-1.

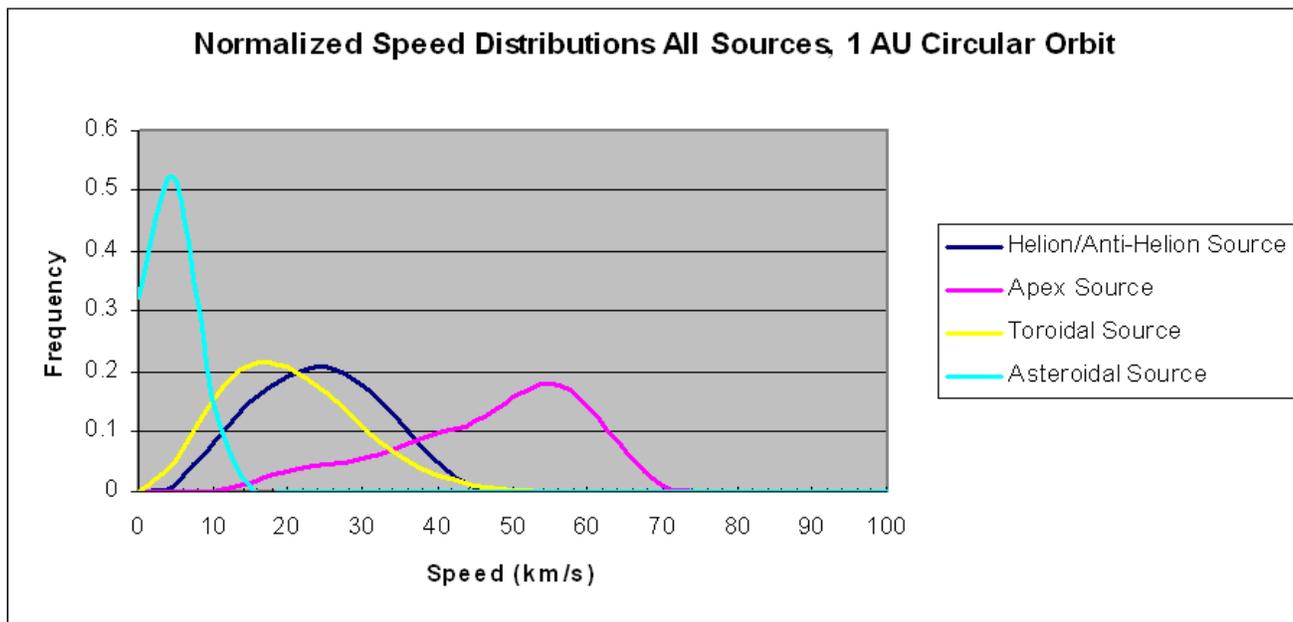
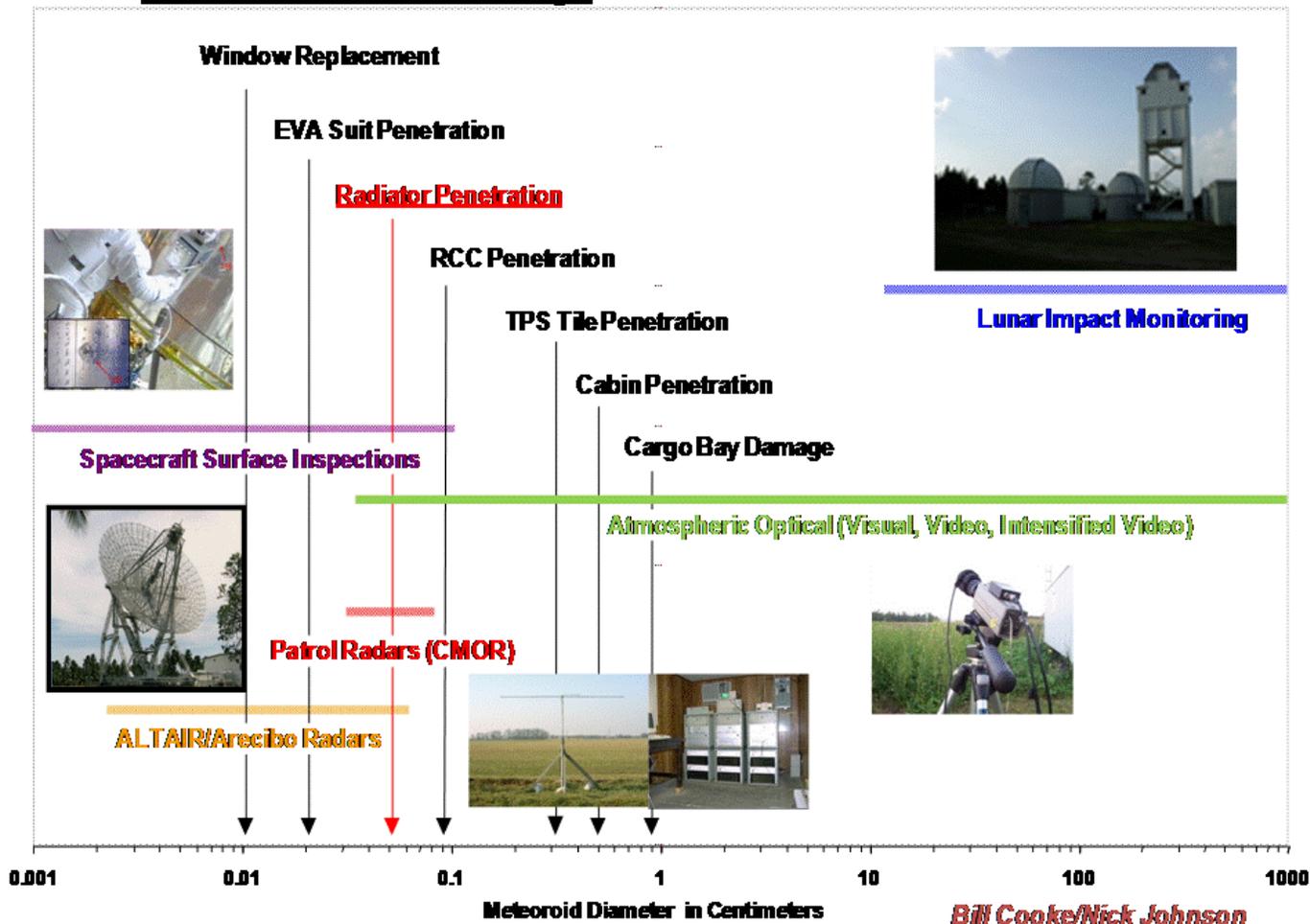


Figure I-2. Speed distributions associated with sporadic sources; computed for 1 AU distance from Sun.

Table I-1. Major annual meteor showers

Shower Name	Approx Date	Hourly Rate +/-	# of Days
Quadrantids	Jan 03	40	1
Lyrids	Apr 21	15	2
Eta Aquarids	May 04	20	3
Delta Aquarids	July 28	20	7
Perseids	Aug 13	70	5
Orionids	Oct 21	25	2
South Taurids	Nov 03	15	Weeks
Leonids	Nov 17	15	Broad range
Geminids	Dec 13	100	3
Ursids	Dec 22	15	2

Potential Shuttle Damage



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